APPENDIX F
DIRECT AND INDIRECT IMPACTS: ASSESSMENT METHODOLOGY

This appendix briefly describes the methods used to assess the potential direct and indirect effects of the alternatives in this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*. Included in this appendix are discussions of general impact assessment methodologies for land resources, infrastructure, noise and vibration, air quality, geology and soils, water resources, ecological resources, cultural resources, public and occupational health and safety, transportation, socioeconomics, waste management, and environmental justice. Each section includes a description of the affected resources, region of influence, and impact assessment method. Detailed descriptions of the methods for evaluating impacts on air quality, groundwater, ecological risk, and cumulative impacts are presented in Appendices G, O, P, and R, respectively. Descriptions of the methods for evaluating the human health effects related to (1) intra- and intersite transportation, (2) environmental justice concerns, and (3) normal operations and facility accidents are presented in Appendices H, J, and K, respectively.

Methods for assessing environmental impacts vary for each resource area. As presented in *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)*, Appendix G, "Air Quality Analysis," for example, pollutant emissions from tank waste retrieval, treatment, and disposal and tank closure activities were evaluated to determine their effect on ambient concentrations and their compliance with ambient air quality standards. Comparison with regulatory standards is a commonly used method for benchmarking environmental impacts, and appropriate comparisons were made in a number of resource analyses to provide perspective on the magnitude of identified impacts. For waste management, waste generation rates were compared with the capacities or expected capacities of waste management facilities. Impacts in all resource areas were estimated using a consistent set of input variables and computations. The impacts at Idaho National Laboratory (INL) resulting from the two options under the FFTF Decommissioning alternatives are addressed in the affected resource areas. Moreover, efforts were made to ensure that calculations in all areas used accepted protocols and up-to-date models.

F.1 LAND RESOURCES

F.1.1 Land Use

F.1.1.1 Description of Affected Resources

Land use is defined as the way land is developed and used in terms of the kinds of anthropogenic activities that occur (such as agriculture and residential and industrial areas) (EPA 2006). Analysis of land use includes the land on and adjacent to the Hanford Site (Hanford) and INL, the physical features that influence current or proposed uses, pertinent land use plans and regulations, and land ownership and availability. The region of influence (ROI) for land use impact assessment encompasses Hanford, including the 200 Areas, 400 Area, and Borrow Area C, as well as areas immediately surrounding the site.

F.1.1.2 Description of Impact Assessment

The amount of land disturbed and the conformity of disturbance with existing land use designations were considered in evaluating potential impacts (see Table F–1). The analysis focused on the net land area affected, its relationship to conforming and nonconforming land uses, current land use designations, and other factors pertaining to land use. Total land area requirements considered include those areas to be occupied by the required footprint of new facilities in conjunction with any additional parking, construction laydown areas, or supporting roadways. Land use assessment methodology and analysis are discussed further in Chapter 3, Section 3.2.1.1.

Table F–1. Land Use and Visual Resource Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Land use	Acreage of affected areas	Facility acreage requirements	Area converted to project use
	Existing land use designations	Location of facilities on the site; expected modifications of site activities and uses to accommodate the alternatives	Incompatibility with existing or future land use
Visual resources	Current appearance of 200 Areas, 400 Area, Borrow Area C, and Idaho National Laboratory's Materials and Fuels Complex and Idaho Nuclear Technology and Engineering Center, as well as current visual resource management classification	Location of facilities on the site; facility dimensions and appearance	Changes in appearance of 200 Areas, 400 Area, Borrow Area C, and Idaho National Laboratory's Materials and Fuels Complex and Idaho Nuclear Technology and Engineering Center, as well as current visual resource management classification

F.1.2 Visual Resources

F.1.2.1 Description of Affected Resources

Visual resources are the natural and manmade features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The ROI for visual resources includes the geographic area from which activities associated with the various alternatives may be seen by members of the public. This would generally include nearby higher elevations and public roadways.

F.1.2.2 Description of Impact Assessment

Visual resource assessments are based on a description of the viewshed and the U.S. Bureau of Land Management's visual resource management classification (BLM 1986). A qualitative visual resource analysis was conducted to determine whether disturbances associated with project activities would alter the visual environment. Classifications of visual contrast settings are provided in Table F–2. Classifications were derived from an inventory of scenic qualities, sensitivity levels, and distance zones for particular areas. For example, the classification of the 200-West Area from State Route 240 is Class IV.

Table F–2. U.S. Bureau of Land Management Visual Resource Classifications

Classification	Visual Settings
Class I	Very limited management activity; natural ecological change.
Class II	Management activities related to solitary small buildings and dirt roads may be seen, but should not attract the attention of the casual observer.
Class III	Management activities may attract attention, but should not dominate the view of the casual observer; the natural landscape still dominates buildings, utility lines, and secondary roads.
Class IV	Management activities related to clusters of two-story buildings, large industrial/office complexes, and primary roads, as well as limited clearcutting for utility lines or ground disturbances, may dominate the view and be the major focus of viewer attention.

Source: BLM 1986:6, 7.

The visual resource analysis focused on the degree of contrast between the proposed actions and the surrounding landscape, the location and sensitivity levels of public vantage points, and the visibility of the proposed actions from the vantage points. The distance from a vantage point to the affected area was also considered, as distance can diminish the degree of contrast and visibility. A qualitative assessment of the degree of contrast between proposed facility construction and operations and the existing visual landscape is presented, as applicable.

Thus, to determine the range of the potential visual effects of new facilities, the analysis considered the potential impacts of construction and operations in light of the aesthetic quality of surrounding areas, as well as the visibility of proposed activities and facilities from public vantage points. The visual resource assessment methodology and analysis are discussed further in Chapter 3, Section 3.2.1.2.

F.2 INFRASTRUCTURE

F.2.1 Description of Affected Resources

Site infrastructure includes the physical resources that compose the ground transportation and utility systems required to support the construction, operations, and deactivation of facilities associated with the various alternatives and options under consideration in this *TC & WM EIS*. It also includes the capacities of the (1) onsite road networks; (2) electric power transmission and distribution system; (3) natural gas and liquid fuel (i.e., fuel oil, diesel fuel, and gasoline) storage and conveyance systems; and (4) water supply system.

The ROI is generally limited to the boundaries of the site. However, should infrastructure requirements exceed site capacities, the ROI would be expanded (for analysis) to include the sources of additional supply. For example, if electrical demand (with added facilities) exceeded site availability, then the ROI would be expanded to include the likely source of additional power (i.e., the electric power pool currently supplying the site).

F.2.2 Description of Impact Assessment

In general, utility infrastructure impacts were assessed by evaluating the requirements of each alternative, including associated activities and facility demands, against site capacities. Impacts were assessed for each utility infrastructure resource (electricity, fuel, and water) for the various alternatives (see Table F–3). Tables reflecting site availability and infrastructure requirements were developed for each alternative. Data for these tables were obtained from documentation[1] describing the existing

1 For applicable source data, see the documentation referenced in Chapter 3, Sections 3.2.2 and 3.3.2, of this *TC & WM EIS*.

infrastructure at the facility site locations and from data reports prepared to support this environmental impact statement (EIS) in regard to proposed tank closure, Fast Flux Test Facility decommissioning, and waste management activities (SAIC 2010a, 2010b, 2010c).

Table F–3. Infrastructure Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Electricity (energy consumption)	Site/facility area capacity and current usage	Activity and facility requirements	Additional requirement (with added facilities) exceeding facility area/site capacity
Fuel (natural gas, gasoline, diesel fuel[a])			
Water			

[a] Includes No. 2 diesel fuel (road diesel) and heating fuel oil.

Any projected demand for infrastructure resources exceeding site availability can be regarded as an indicator of impact. Whenever projected demand approaches or exceeds capacity, further analysis of that resource is warranted. Often, design changes can mitigate the impact of additional demand for a given resource. For example, substituting fuel oil for natural gas (or vice versa) for heating or industrial processes can be accomplished at little cost during the design of a facility, provided the potential for impact is identified early. Similarly, a dramatic "spike" in peak demand for electricity can sometimes be mitigated by changes to operational procedures or parameters.

Although ground transportation infrastructure is part of the physical infrastructure, incremental demands (e.g., new roadways to support project activities) were not separately quantified, but were assessed as part of the land use impacts analysis (see Section F.1.1.2). Note that the methodology for assessing local roadway traffic impacts, which are related to projected changes in facility site employment and local population, is described in Section F.11.2. The infrastructure assessment methodology and analysis are discussed further in Chapter 3, Section 3.2.2.

F.3 NOISE AND VIBRATION

F.3.1 Description of Affected Resources

Noise, or sound, results from the compression and expansion of air or some other medium when an impulse is transmitted through it. Sound requires a source of energy and a medium for transmitting the sound wave. Propagation of sound is affected by various factors, including meteorology, topography, and barriers. Noise is undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (e.g., hearing, sleep), damage hearing, or diminish the quality of the environment.

Noise-level measurements used to evaluate the effects of nonimpulsive sound on humans are adjusted using an A-weighting scale that accounts for the hearing response characteristics (i.e., frequency) of the human ear. Noise levels are expressed in decibels (dB) or, in the case of A-weighted measurements, decibels A-weighted (dBA). The U.S. Environmental Protection Agency (EPA) has developed noise-level guidelines for different land use classifications (EPA 1974). The EPA guidelines identify a 24-hour average exposure level (energy-equivalent sound level) of no more than 70 dBA of intermittent environmental noise to prevent hearing loss. Likewise, day-night average levels of 55 dBA outdoors and 45 dBA indoors are identified as the limits to prevent activity interference and annoyance. The State of Washington has adopted noise-level standards for combinations of source classifications and receiving property classifications. The Washington State standard maximum noise-level limit is 60 dBA for industrial areas impacting a residential area and 50 dBA at night (WAC 173-60). Except for prohibition of nuisance noise, neither the State of Idaho nor local governments have established regulations that specify acceptable community noise levels applicable to INL.

Noise from facility construction or operations and associated traffic could affect human and animal populations. The ROI at Hanford includes the 200 Areas; 400 Area; borrow areas; and surrounding areas, including transportation corridors, where proposed activities might increase noise levels. At INL, the ROI includes the Materials and Fuels Complex, Idaho Nuclear Technology and Engineering Center, and surrounding areas, including transportation corridors, where proposed activities might increase noise levels. Transportation corridors most likely to experience increased noise levels are those roads within a few miles of the site boundary that carry most of the site's employee and shipping traffic.

Noise-level data representative of site environs were obtained from existing reports (see Chapter 3, Sections 3.2.3 and 3.3.3). The acoustic environment was further described in terms of existing noise sources for the proposed locations and traffic noise levels along access routes.

F.3.2 Description of Impact Assessment

Noise impacts associated with the alternatives may result from construction, operations, deactivation, decontamination, and closure activities, including increased traffic (see Table F–4). Impacts of proposed activities under each alternative were assessed according to the types of noise sources and the facility site locations relative to the site boundary and noise-sensitive receptors. Potential traffic noise impacts were assessed based on the likely increase in traffic volume. The increases in employee and truck traffic, as reported in the discussion of local traffic (see Chapter 4, Sections 4.1.9, 4.2.9, and 4.3.9), were compared with the existing average traffic volume (see Chapter 3, Sections 3.2.9.4 and 3.3.9.4). For the purpose of comparison between the alternatives, the increase in traffic noise level in dBA can be estimated as 10 times the log of the ratio of the projected traffic volume to the existing traffic volume. Possible impacts on wildlife were evaluated based on the possibility of sudden loud noises occurring during site activities under each alternative.

Table F–4. Noise and Vibration Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Noise and vibration	Identification of sensitive offsite receptors (e.g., nearby residences, nearby threatened and endangered wildlife habitat); description of noise levels and noise and vibration sources in the site vicinity	Description of noise and vibration sources; shipment and workforce traffic estimates	Increase in day-night average sound level at sensitive receptors

F.4 AIR QUALITY

F.4.1 Description of Affected Resources

Air pollution refers to the direct or indirect introduction of any substance into the air that could have one or more of the following effects:

- Endanger human health
- Harm living resources and ecosystems
- Damage material property
- Impair or interfere with the comfortable enjoyment of life and other legitimate uses of the environment

For the purpose of this *TC & WM EIS*, only outdoor air pollutants were addressed. These may be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants or by reaction with normal atmospheric constituents that may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air quality is affected by air pollutant emission characteristics, meteorology, and topography.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. The ambient air quality standards established by Federal and state agencies allow an adequate margin of safety for the protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards are considered acceptable.

Pollutants of concern are primarily those for which Federal and state ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds. Criteria air pollutants are listed in the "National Primary and Secondary Ambient Air Quality Standards" (40 CFR 50). Hazardous air pollutants and other toxic compounds are those listed in Title I of the Clean Air Act, as amended (42 U.S.C. 7401 et seq.); those regulated by the "National Emission Standards for Hazardous Air Pollutants" (40 CFR 61); and those that have been proposed or adopted for regulation by the applicable state or are listed in state guidelines. States may set ambient standards that are more stringent than the National Ambient Air Quality Standards (NAAQS) (40 CFR 50). The more stringent of the Federal or state standards are used in this EIS.

Areas with air quality better than the NAAQS for criteria air pollutants are designated as "attainment," while areas with air quality worse than the NAAQS for such pollutants are designated as "nonattainment." Areas may be designated as "unclassified" when sufficient data for attainment-status designation are lacking. Attainment-status designations are assigned by county, metropolitan statistical area, consolidated metropolitan statistical area, or portions thereof, or by air quality control regions. Air quality control regions designated by EPA are listed in "Designation of Areas for Air Quality Planning Purposes" (40 CFR 81). The areas within Hanford and the surrounding counties are designated as attainment (40 CFR 81.348), as are the areas within INL and the surrounding counties (40 CFR 81.313).

For locations within an attainment area for criteria air pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new or modified sources and establish allowable increments of pollutant concentrations. Three Prevention of Significant Deterioration classifications are specified, using the criteria established in the Clean Air Act. Class I areas include national wilderness areas; memorial parks larger than 2,020 hectares (5,000 acres); national parks larger than 2,430 hectares (6,000 acres); and areas that have been redesignated as Class I. Class II areas include all areas not designated as Class I. No Class III areas have been designated (42 U.S.C. 7472 et seq.). The Class I area nearest to Hanford is about 145 kilometers (90 miles) to the west (see Chapter 3, Section 3.2.4.1, of this EIS). The Class I area nearest to INL is about 53 kilometers (33 miles) to the west-southwest (see Chapter 3, Section 3.3.4.1.2).

The ROI for air quality encompasses an area surrounding a site that is potentially affected by air pollutant emissions caused by implementation of the alternatives. The air quality impact area normally evaluated is the area in which concentrations of criteria pollutants would increase more than a significant amount in a Class II area (based on the averaging period and pollutant: 1 microgram per cubic meter for the annual average for sulfur dioxide, nitrogen dioxide, and PM_{10} [particulate matter with an aerodynamic diameter less than or equal to 10 micrometers]; 5 micrograms per cubic meter for the 24-hour average for sulfur dioxide and PM_{10}; 500 micrograms per cubic meter for the 8-hour average for carbon monoxide; 25 micrograms per cubic meter for the 3-hour average for sulfur dioxide; and 2,000 micrograms per cubic meter for the 1-hour average for carbon monoxide (40 CFR 51.165). Generally, this ROI covers a few kilometers downwind from the source. Further, for sources within 100 kilometers (60 miles) of a Class I area, the air quality impact area evaluated would include the Class I area if the increase in concentration of any air pollutants for which there are Prevention of Significant Deterioration increments were greater than 1 microgram per cubic meter (24-hour average). The area of the ROI depends on emission source characteristics, pollutant types, emission rates, and meteorological and topographical conditions. For analysis purposes, impacts at Hanford were evaluated at the Hanford Reach boundary and within Hanford along State Route 240, to which the public has access for averaging periods of 1 to 24 hours; at the Hanford boundary for annual averaging periods; and at an additional area 10 kilometers (6 miles) beyond these boundaries in which maximum contributions to pollutant concentrations are expected to be identified.

Impacts at INL were evaluated at the boundary and at roads within INL to which the public has access.

Baseline air quality is typically described in terms of pollutant concentrations modeled for existing sources at each site and background air pollutant concentrations measured near each site. For this analysis, emission data from existing sources at Hanford were obtained from the *Calendar Year 2005 Nonradioactive Inventory of Airborne Emissions Report* (Johnson 2006); concentrations from these data were modeled using the EPA-recommended AERMOD [American Meteorological Society/ U.S. Environmental Protection Agency Regulatory Model] dispersion model (EPA 2004, 2009). Emissions data for INL were obtained from an emission inventory database for 2006 (Depperschmidt 2007).

F.4.2 Description of Impact Assessment

Potential air quality impacts of pollutant emissions from construction, normal operations, deactivation, decommissioning, and closure activities were evaluated for each alternative, as appropriate. This assessment included a comparison of pollutant concentrations under each alternative with applicable Federal and state ambient air quality standards (see Table F–5). If both Federal and state standards exist for a given pollutant and averaging period, compliance was evaluated using the more stringent standard. Operational air pollutant emissions data for each alternative were based on engineering analyses that resulted in values of emissions that would overestimate actual emissions.

Table F–5. Air Quality Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Criteria air pollutants and other regulated pollutants[a]	Measured and modeled ambient concentrations (micrograms per cubic meter) from existing sources at the site.	Emission rate (kilograms per year) of air pollutants from facility; source characteristics (stack location, height and diameter, exit temperature and velocity).	Alternative and total site concentrations of each pollutant at or beyond the site boundary or within the boundary on a public road compared with the applicable standard.
Toxic and hazardous air pollutants[b]			Alternative concentration of each pollutant at or beyond the site boundary or within the boundary on a public road compared with the acceptable source impact level. The concentration for the nearby noninvolved member was used to calculate Hazard Quotient or cancer risk.

[a] Carbon monoxide; hydrogen fluoride; lead; nitrogen oxides; ozone; particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; sulfur dioxide; total suspended particulates, and volatile organic compounds.

[b] "Hazardous Air Pollutants" (Clean Air Act, Section 112) are those regulated by the National Emission Standards for Hazardous Air Pollutants and by state regulations.

For each alternative, as appropriate, contributions to offsite air pollutant concentrations were modeled on the basis of guidance presented in EPA's "Guideline on Air Quality Models" (40 CFR 51, Appendix W). The EPA-recommended model AERMOD (EPA 2004, 2009) was selected as an appropriate model to use for air dispersion modeling for Hanford because it is designed to support the EPA regulatory modeling program and predicts conservative impacts. For construction activities at INL, the EPA SCREEN 3 dispersion model (EPA 1995) was used to estimate contributions to offsite air pollutant concentrations.

The modeling analysis incorporated conservative assumptions that generally overestimate pollutant concentrations. The maximum modeled concentration and averaging time for each pollutant were selected for comparison with the applicable standard. The concentrations evaluated were the maximum occurring at or beyond the site boundary and at a public access road or other publicly accessible area within the site. Concentrations of the criteria and toxic air pollutants were presented for each alternative. Five years of representative hourly meteorological data were used for Hanford.

Details of the air quality impact assessment methodology and analysis are discussed further in Appendix G.

F.5 GEOLOGY AND SOILS

F.5.1 Description of Affected Resources

Geologic resources encompass consolidated and unconsolidated earth materials, including rock and mineral assets such as ore and aggregate materials (e.g., sand, gravel) and fossil fuels such as coal, oil, and natural gas. Geologic conditions include hazards such as earthquakes, faults, volcanoes, landslides, sinkholes, and other conditions leading to land subsidence and unstable soils. Soil resources include the loose surface materials of the earth in which plants grow, usually consisting of mineral particles from disintegrating rock, organic matter, and soluble salts. Certain soils are important farmlands that are designated as such by the U.S. Department of Agriculture Natural Resources Conservation Service. Its regulations define important farmlands, including prime, unique, and other farmland of statewide or local importance (7 CFR 657.5), that may be subject to the Farmland Protection Policy Act (7 U.S.C. 4201 et seq.).

Geology and soils were considered with respect to those attributes and geologic and soil resources that could be affected by the alternatives, as well as those geologic conditions that could affect each alternative and associated facilities. The ROI for geology and soils includes the Hanford and INL affected facility areas and nearby offsite areas that are subject to disturbance due to facility construction, decontamination and decommissioning (D&D), and tank closure activities, as well as those areas beneath existing or new facilities that would remain inaccessible for the life of the facilities. Conditions that could affect the integrity and safety of existing or proposed new facilities over the timeframe associated with each alternative include large-scale geologic hazards (e.g., earthquakes, volcanic activity, landslides, and land subsidence) and local hazards associated with the site-specific attributes of the soil and bedrock beneath the site facilities. Thus, the area within which these geologic conditions exist is also used to define the ROI for this resource area.

F.5.2 Description of Impact Assessment

Construction, operations, deactivation, closure, and D&D activities under each of the alternatives were considered from the perspective of direct impacts on specific geologic resources and soil attributes to encompass the consumption of geologic resources. Facility construction, D&D, and tank closure activities were the focus of the impact assessment for geologic and soil resources; hence, the key factors in the analysis were the (1) land area to be disturbed and geologic resources consumed to support the alternatives considered; (2) depth and extent of excavation work to support facility construction, facility D&D, and closure activities; (3) land areas occupied during operations; and (4) identification of unstable geologic strata (such as soils or sediments prone to subsidence, liquefaction, shrink-swell, or erosion) (see Table F–6).

Table F–6. Geology and Soils Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Geologic hazards	Presence of geologic hazards within the region of influence	Location of facilities	Potential for damage to facilities
Mineral and energy resources	Presence of any rare and/or valuable mineral or energy resources on the site and availability of geologic resources within the region of influence	Location of facilities and project activity demands	Potential to consume, destroy, or render resources inaccessible
Important farmland soils	Presence of prime or other important farmland soils near the facility site locations	Location of facilities	Conversion of important farmland soils to nonagricultural use

The geology and soils impacts analysis also considered risks to facilities (existing, new, or modified) from large-scale geologic hazards such as faulting and earthquakes, lava extrusions and other volcanic activity, landslides, and sinkholes (i.e., conditions that tend to affect broad expanses of land). In general, the facility hazard assessment was based on the presence of any identified hazard and the distance of the facilities from it. This element of the assessment included collection of site-specific information regarding the potential for impacts on site facilities from local and large-scale geologic conditions. Historical seismicity within an approximate 805-kilometer (500-mile) radius of Hanford was reviewed, and potential earthquake source areas were identified as a means of assessing the potential for future earthquake activity. Earthquakes are described in this *TC & WM EIS* in terms of classification scheme and parameters, as presented in Table F–7. Probabilistic earthquake ground-motion data, including peak (horizontal) ground acceleration and response spectral acceleration, were evaluated for select facility areas to provide a comparative assessment of seismic hazard.

Estimates of probabilistic ground motion at a particular location consider earthquake-shaking at all future possible earthquake magnitudes and at all possible distances from the location (USGS 2008a). Peak ground acceleration indicates what an object on the ground would experience during an earthquake and approximates what a short structure would be subjected to in terms of horizontal force. It does not account for the range of energies experienced by a building during an earthquake, particularly taller buildings. Measures of spectral acceleration account for the natural period of vibration of structures (short buildings have short natural vibration periods [up to 0.6 seconds], and taller buildings have longer vibration periods [0.7 seconds or longer]) (USGS 2008b). Both parameters are used by the U.S. Geological Survey (USGS) National Seismic Mapping Project. USGS's latest National Earthquake Hazards Reduction Program (NEHRP) maps are based on spectral acceleration and depict maximum considered earthquake ground motions of 0.2- and 1.0-second spectral accelerations based on a 2 percent probability of exceedance in 50 years (corresponding to an annual probability of occurrence of about 1 in 2,500). The NEHRP maps have been adapted for use in the seismic design portions of the International Building Code (USGS 2007).

The NEHRP maps were developed based on the recommendations of the Building Seismic Safety Council's Seismic Design Procedures Group (BSSC 2004a, 2004b). The Seismic Design Procedures Group–recommended maximum considered earthquake ground-motion maps are derived from the USGS probabilistic hazard maps with additional modifications that incorporate deterministic ground motions in selected areas and the application of engineering judgment (USGS 2007). Note that the maximum considered earthquake maps are based on a reference site condition (firm rock) and are suitable for determining estimates of maximum considered earthquake ground shaking for design purposes at most sites. For sites with nonreference conditions and for design of buildings requiring a higher degree of seismic safety, site-specific design procedures must be used (BSSC 2004b:17, 18).

U.S. Department of Energy (DOE) Order 420.1B specifically requires nuclear and nonnuclear facilities to be designed, constructed, and operated so that the public, workers, and environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. The order stipulates natural phenomena hazards mitigation requirements for DOE facilities and specifically provides for re-evaluation and upgrade of existing DOE facilities where there is a significant degradation in the safety basis for the facility. DOE Standards 1020-2002 and 1023-95 implement DOE Order 420.1B and provide criteria for design of new structures, systems, and components, as well as for evaluation, modification, or upgrade of existing structures, systems, and components, so that DOE facilities can safely withstand the effects of natural phenomena hazards such as earthquakes. The criteria specifically reflect adoption of the seismic design and construction provisions and associated seismic hazard maps of the International Building Code as the minimum standard for design and evaluation of DOE facilities (i.e., for Performance Category 1 and 2 structures, systems, and components). For structures, systems, and components requiring a higher level of performance from a safety perspective (i.e., Performance Category 3 and 4), a more rigorous design analysis is required, including performance of a probabilistic seismic hazard assessment to determine the design-basis earthquake.

Table F–7. The Modified Mercalli Intensity Scale of 1931 with Generalized Correlations to Magnitude, Earthquake Classification, and Peak Ground Acceleration

Modified Mercalli Intensity[a]	Observed Effects of Earthquake[a]	Approximate Magnitude[b]	Class	Peak Ground Acceleration[c] (g)
I	Usually not felt except by a very few persons under very favorable conditions.	Less than 3	Micro	Less than 0.0017
II	Felt by only a few persons at rest, especially on the upper floors of buildings.	3 to 3.9	Minor	0.0017 to 0.014
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck.			
IV	Felt indoors by many; outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sounds. Sensation like heavy object striking building. Standing motorcars rock noticeably.	4 to 4.9	Light	0.014 to 0.039
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.			0.039 to 0.092
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.	5 to 5.9	Moderate	0.092 to 0.18
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	6 to 6.9	Strong	0.18 to 0.34
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings, with partial collapse. Damage great in poorly built structures. Falling chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.	7 to 7.9	Major	0.34 to 0.65
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.			0.65 to 1.24
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.			1.24 and higher
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	8 and higher	Great	
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.			

[a] Intensity is a unitless expression of observed effects of earthquake-produced ground shaking. Effects may vary greatly between locations based on earthquake magnitude, distance from the earthquake, and local subsurface geology. The descriptions given are abbreviated from the Modified Mercalli Intensity Scale of 1931.

[b] Magnitude is a logarithmic measure of the strength (size) of an earthquake related to the strain energy released by it. There are several magnitude "scales" (mathematical formulas) in common use, including local "Richter" magnitude, body-wave magnitude, and surface-wave magnitude. Each has applicability for measuring particular aspects of seismic signals and may be considered equivalent within each scale's respective range of validity. For very large earthquakes, the moment magnitude scale provides the best overall measurement of earthquake size.

[c] Acceleration is expressed as a factor that should be multiplied by Earth's gravitational acceleration (g) (i.e., g is equal to 980 centimeters [386 inches] per second squared). Given values are correlated to Modified Mercalli Intensity based on measurements of California earthquakes (Wald et al. 1999). Site-specific earthquake history, ground motion, and risk assessment data for the Hanford Site and Idaho National Laboratory are presented in Chapter 3, Sections 3.2.5.1.4 and 3.3.5.1.4, respectively.

Key: g=gravitational acceleration.

Source: Compiled from USGS 2008c, 2008d; Wald et al. 1999.

An evaluation was also performed to determine whether estimated requirements for rock, aggregate, soil, and products derived from rock and mineral resources used to support tank waste retrieval, treatment, and disposal; tank closure; and related D&D activities under each of the alternatives could exceed available resource reserves or stockpiles in the ROI. For example, this analysis included provision of borrow materials from onsite quarries and borrow pits to support construction of surface barriers for landfill closure of tank farms and waste disposal sites and to provide backfill for clean closure of tank farms under select alternatives. This was accomplished by comparing projections of resource demands for construction, operations, deactivation, closure, and D&D with resource availability analyses for the site and the region. In addition, the analysis of impacts on geologic resources included a determination of whether the proposed activities at a specific site could destroy or preclude the use of valuable rock, mineral, or energy resources.

Pursuant to the Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 et seq.) and its implementing regulations, the presence of important farmland soils, including prime farmland, was also evaluated. This act requires agencies to make Farmland Protection Policy Act evaluations part of the National Environmental Policy Act process to reduce the conversion of farmland to nonagricultural uses by Federal projects and programs. However, otherwise qualifying farmlands in or already committed to urban development; land acquired for a project on or prior to August 4, 1984; and lands acquired or used by a Federal agency for national defense purposes are exempt from the act's provisions (7 CFR 658.3 and 658.7).

F.6 WATER RESOURCES

F.6.1 Description of Affected Resources

Water resources are the surface and subsurface waters that are suitable for human consumption, aquatic or wildlife use, agricultural purposes, irrigation, recreation, or industrial/commercial purposes. The ROI used for water resources encompasses those surface-water and groundwater systems at Hanford and INL that could be impacted by water withdrawals, effluent discharges, and spills or stormwater runoff associated with facility construction, operations, deactivation, closure, and related D&D activities under the alternatives. As such, the assessment methodologies described in the following subsections relate to the analysis of the proposed activities under the various alternatives and options that would generally result in short-term impacts (i.e., impacts limited to the timeframe during which the activity would be performed). The impact methodologies employed to assess the potential for long-term impacts on surface-water and groundwater resources of past releases to the vadose zone and groundwater at Hanford, as well as of waste retrieval and disposal and tank closure, in particular, are described in the introduction to Chapter 5, as well as Appendices M, N, and O.

F.6.2 Description of Impact Assessment

Analysis of the potential impacts on water resources consisted of comparing project activity data and best-available engineering-basis estimates regarding water use and effluent discharges with applicable regulatory standards, design parameters and standards commonly used in the water and wastewater engineering fields, and recognized measures of environmental impact. Certain assumptions were made to facilitate the impacts assessment: (1) all water supply production and treatment facilities and the Effluent Treatment Facility would be available and upgraded as necessary in accordance with the timeframe considered under each alternative; (2) the Effluent Treatment Facility would meet the effluent limitations imposed by the respective National Pollutant Discharge Elimination System permits and/or the state-issued discharge permit; and (3) any stormwater runoff from construction and operations activities would be handled in accordance with the regulations of the appropriate permitting authority. It was also assumed that, during construction and other land-disturbing activities, sediment fencing or other erosion-control devices would be used to mitigate short-term adverse impacts of sedimentation and, as appropriate, stormwater holding ponds would be constructed to lessen the impacts of runoff on surface-water quality.

F.6.2.1 Water Use and Availability

Impacts on water use and availability were generally assessed by determining changes in the volume of current water usage and effluent discharges as a result of the proposed activities (see Table F–8). Where project activities were assumed to use surface water, no credit was taken for effluent discharges back to surface waters.

Table F–8. Water Use and Availability Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Surface-water availability	Surface waters near the facilities, including average flow, low flow, and current usage	Volume of withdrawals from, and discharges to, surface waters	Changes in availability to local/downstream users of water for human consumption, irrigation, or animal feeding
Groundwater availability	Groundwater near the facilities, including existing water rights for major water users and current usage	Volume of withdrawals from, and discharges to, groundwater	Changes in availability of groundwater for human consumption, irrigation, or animal feeding

F.6.2.2 Water Quality

The water quality impact assessment for this *TC & WM EIS* analyzed how routine effluent discharges and nonroutine releases (e.g., spills, containment failure) to surface water, as well as discharges reaching groundwater, from new facilities required under each alternative could potentially affect current water quality over the short term. The impacts of the alternatives were assessed as summarized in Table F–9, including a comparison of the projected effluent quality with relevant regulatory standards and implementing regulations, such as the Clean Water Act of 1972 (33 U.S.C. 1251 et seq.), Safe Drinking Water Act of 1974 (42 U.S.C. 300(f) et seq.), state laws, and existing site permit conditions. The impact analyses evaluated the potential for contaminants to affect receiving water quality as a result of spills and other releases under the alternatives. Separate analyses were conducted for surface water (see Chapter 4, Section 4.1.6) and groundwater (see Chapter 5, Section 5.1.1, and Appendices M, N, and O) impacts.

Table F–9. Water Quality Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Surface-water quality	Surface waters near the facility locations in terms of stream classifications and changes in water quality	Expected contaminants and contaminant concentrations in discharges to surface waters	Exceedance of relevant surface-water quality criteria or standards under the Clean Water Act or state regulations and existing permits
Groundwater quality	Groundwater near the facility locations in terms of classification, presence of designated sole-source aquifers, and changes in quality of groundwater	Expected contaminants and contaminant concentrations in discharges that could reach groundwater	Contaminant concentrations in groundwater exceeding relevant standards or criteria established in accordance with the Safe Drinking Water Act or state regulations and/or existing permits

F.6.2.2.1 Surface-Water Quality

The evaluation of potential short-term surface-water-quality impacts focused on the quality and quantity of any effluents (including stormwater) discharged as a result of new facility construction, operations, facility D&D, and tank closure activities, as well as other releases, and the quality of the receiving stream up- and downstream from the discharges. The evaluation of effluent quality featured a review of the expected parameters, such as the expected average and maximum flows and the nature of, and parameter concentrations in, expected effluents. Parameters of concern included total suspended solids, heavy metals, radionuclides, organic and inorganic chemicals, and any other constituents that could affect the local environment. Factors that currently degrade water quality were also identified. Data from existing water-quality data sources were compared with expected discharges from the facilities to determine the potential for, and relative impacts on, surface waters.

F.6.2.2.2 Groundwater Quality

Potential short-term groundwater quality impacts associated with effluent discharges and other contaminant releases associated with new facility construction, operations, D&D, and tank closure were examined. Available engineering estimates of contaminant concentrations were weighed against applicable Federal and state groundwater quality standards, effluent limitations, and drinking water standards to determine the impacts of each alternative. In addition, the consequences of groundwater use, including dewatering, and effluent discharges on other site groundwater conditions were evaluated. The methods employed to evaluate long-term surface-water and groundwater impacts are presented in Appendices M, N, and O.

F.6.2.3 Waterways and Floodplains

The locations of waterways (e.g., ponds, lakes, streams) and delineated floodplains or zones were identified from maps and other existing documents to assess the potential for impacts resulting from proposed new facility construction and facility modification and operations, including direct effects on hydrologic characteristics.

F.7 ECOLOGICAL RESOURCES

F.7.1 Description of Affected Resources

Ecological resources include terrestrial and aquatic resources (plants and animals), threatened and endangered species, and wetlands that could be affected by the alternatives. The ROI evaluated for ecological impacts encompasses those areas within the 200 Areas, the 400 Area, and Borrow Area C that would be potentially disturbed by facility construction, operations, deactivation, and closure. At Hanford, surveys of facility locations were conducted to determine whether important ecological resources were present (Sackschewsky 2003a, 2003b; Sackschewsky and Downs 2007).

Terrestrial resources are defined as those plant and animal species and communities that are most closely associated with the land; for aquatic resources, a water environment. Wetlands are defined by the U.S. Army Corps of Engineers and EPA as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

Endangered species are defined under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) as those in danger of extinction throughout all or a large portion of their range. Threatened species are defined as those species likely to become endangered within the foreseeable future. The U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration propose the addition of species to the lists of threatened and endangered species. They also maintain a list of "candidate" species for which they have evidence that listing may be warranted, but is currently precluded by the need to list species more in need of Endangered Species Act protection. Candidate species do not receive legal protection under the Endangered Species Act, but should be considered in project planning in case they are listed in the future. Critical habitat for threatened and endangered species is designated by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service. Critical habitat is defined as a specific area that contains physical and biological features essential to the conservation of species and that may require special management consideration or protection. The States of Washington and Idaho designate species as endangered or threatened, as well as a number of other special-status designations.

F.7.2 Description of Impact Assessment

Impacts on ecological resources may occur as a result of land disturbance, water use, human activity, and noise from construction, operation, and deactivation of facilities associated with the various alternatives (see Table F–10). Night lighting may also impact site ecology. Each of these factors was considered when evaluating the potential impacts of the proposed activities. Terrestrial resources could be directly affected through destruction or modification of habitat. Likely impacts include increased direct mortality and susceptibility to predation. Activities associated with each alternative (e.g., human intrusion and noise) could also cause wildlife to move to adjacent areas with similar habitat. If the receiving areas were already supporting the maximum sustainable number of individuals, competition for limited resources and habitat degradation could result in the loss of some individuals. Therefore, analysis of impacts on terrestrial wildlife was based largely on the extent of plant community loss or modification. Indirect impacts of factors such as human disturbance, noise, and night lighting were evaluated qualitatively.

Impacts on ecological resources may also occur as a result of exposure to radionuclide and chemical air emissions, and surface-water and groundwater contamination under all alternatives. Appendix P describes impact assessment methods and summarizes the results of the impact assessments on ecological resources at both on- and offsite locations. Potential impacts are assessed by comparing predicted exposure concentrations and doses with published effects-based threshold concentrations and doses.

Exposures above effects-based thresholds could potentially cause reduced fertility or increased mortality in exposed populations.

Table F–10. Ecological Resources Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	Alternative	
Terrestrial resources	Terrestrial vegetation and wildlife within the vicinity of facilities	Area disturbed by facility site activities, air emissions, wastewater discharges, and noise	Loss of or disturbance to species and their habitat; emissions and noise values above levels shown to cause impacts on terrestrial resources
Aquatic resources	Aquatic resources within the vicinity of facilities	Facility area air emissions, water source and quantity, and wastewater discharge locations and quantities	Discharges above levels shown to cause impacts on aquatic resources
Wetlands	Wetlands within the vicinity of facilities	Area disturbed by facility site activities, air emissions, and wastewater discharge locations and quantities	Loss of or disturbance to wetlands
Threatened and endangered species	Threatened and endangered species, as well as their habitat, within the vicinity of facilities	Area disturbed by facility site activities, air emissions, noise, water sources and quantities, and wastewater discharge locations and quantities	Similar to measures used in evaluating other terrestrial and aquatic resources and habitats

Project activity impacts on threatened and endangered species, as well as other special status species, and their habitats were determined in a manner similar to that used to evaluate impacts on other terrestrial and aquatic resources and habitats. A list of sensitive species that could be present at each site was compiled. Informal consultations were initiated with the appropriate U.S. Fish and Wildlife Service offices and state-equivalent agencies as part of the impact assessment for sensitive species (see Appendix C).

F.8 CULTURAL RESOURCES

F.8.1 Description of Affected Resources

Cultural resources are indications of human occupation and use of property as defined and protected by a series of Federal laws, regulations, and guidelines. For this *TC & WM EIS*, potential impacts were assessed separately for each of the cultural resource categories: prehistoric resources, historic resources, and American Indian interests. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geologic age and may be sources of information on ancient environments and the evolutionary development of plants and animals. Although not governed by the same historic preservation laws as cultural resources, they could be affected by the proposed actions in much the same manner.

Prehistoric resources are the physical remains of human activities that predate written records. They generally consist of artifacts that may either alone or collectively yield information about the past. Historic resources consist of physical remains that postdate the emergence of written records. In the United States, they are architectural structures or districts, archaeological objects, and archaeological features dating from 1492 and later. Ordinarily, sites less than 50 years old are not considered historic, but exceptions are made for properties of particular importance such as structures associated with World War II or Cold War themes. American Indian interests include sites, areas, and materials considered important to American Indians for religious or heritage reasons. Such interests may include geographic features, plants, animals, cemeteries, battlefields, trails, and environmental features. The ROI for cultural resource analysis encompasses Hanford, including the 200 Areas, 400 Area, and Borrow Area C, as well as areas immediately surrounding the site that potentially would be disturbed by facility construction and other activities and would be occupied during operations of facilities for tank waste retrieval, treatment, and disposal and/or tank closure.

F.8.2 Description of Impact Assessment

The analysis of impacts on cultural resources addressed potential direct and indirect impacts at each facility site location (see Table F–11). To determine whether cultural resources were present, a number of surveys were conducted of facility locations within and adjacent to the 200 Areas, 400 Area, and Borrow Area C (Chatters and Cadoret 1990; Duncan 2007; PNNL 2003, 2007).

Table F–11. Cultural Resources Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Paleontological resources	Paleontological resources within the vicinity of facilities	Location of facilities on the site and facility acreage requirements	Potential for loss, isolation, or alteration of paleontological resources
Prehistoric and historic resources	Prehistoric and historic resources within the vicinity of facilities		Potential for loss, isolation, or alteration of the character of prehistoric and historic resources; introduction of visual, audible, or atmospheric elements that are out of character; neglect of resources listed, or eligible for listing, on the National Register of Historic Places
American Indian interests	American Indian interests within the vicinity of facilities		Potential for loss, isolation, or alteration of the character of American Indian interests; introduction of visual, audible, or atmospheric elements that are out of character

Potential indirect impacts include those associated with reduced access to a resource site, as well as those associated with increased traffic and visitation to sensitive areas. Direct impacts include those resulting from facilities for tank waste management. Consultations to comply with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470 et seq.) were conducted with the State Historic Preservation Officer. Correspondence offering consultation was sent to local American Indian tribes (see Appendix C). The cultural resources assessment methodology and analysis are discussed further in Chapter 3, Section 3.2.8.

F.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

F.9.1 Description of Affected Resources

Public and occupational health and safety analysis examines the potential adverse human health effects of exposure to ionizing radiation and hazardous chemicals. Health effects are determined by identifying the types and quantities of additional radioactive materials and toxic chemicals to which individuals may be exposed and estimating doses or exposures and the resulting indicators of health effects (latent cancer fatalities [LCFs], emergency exposure air concentration guidelines). The impacts of various releases during both normal activities (facility operations, construction, demolition) and postulated accidents on the health of workers and the public were assessed using site-specific factors such as meteorology, population distribution, and distance to nearby receptors. The number of people in the 80-kilometer (50-mile) ROI and their distribution are based on the U.S. Census Bureau's 2010 decennial census (Census 2011a). More-detailed information on the types and quantities of materials released during normal operations and accident conditions is provided in Appendix K.

F.9.2 Description of Impact Assessment

Health effects, in terms of incremental doses or exposures and related risks (LCFs or relationship to exposure thresholds), were assessed based on the types and quantities of materials released. Impacts on involved workers are estimated based on operational experience, engineering estimates, and administrative control levels. Models were used to estimate impacts on the health of noninvolved workers and the public resulting from releases during normal (incident-free) operations. The models included the following:

- GENII [Hanford Environmental Radiation Dosimetry Software System, Generation II], Version 2, for all radioactive air emissions during normal operations (Napier 2007). GENII was selected as an appropriate model for radiation dose analysis because it was developed to model, among other things, radiation doses to individuals and populations from routine releases of radioactive materials into the air and water.

- MACCS [MELCOR Accident Consequence Code System], Version 1.13.1 (MACCS2), for all radioactive materials released during accident conditions (Chanin and Young 1997). MACCS2 was selected as an appropriate model because it was developed for DOE and the U.S. Nuclear Regulatory Commission to calculate radiation doses caused by airborne release of a wide range of radioisotopes. It is specifically recommended by DOE for calculating radiological accident consequences and risks in EISs.

- EPIcode [Emergency Prediction Information Code], Version 7.0, for all hazardous chemicals released during accident conditions (Homann 2003). As one of the computer models included in the DOE Safety Software Central Registry, EPIcode was selected to perform estimates of atmospheric dispersion and resultant downwind concentrations of hazardous chemicals for comparison with human health limits. The codes included in the registry have been determined to be compliant with the DOE Safety Software Quality Assurance requirements (DOE Order 414.1D). These codes are recommended for use by DOE to perform calculations and develop data used to establish the safety basis for DOE facilities and their operation, as well as to support the variety of safety analyses and evaluations developed for these facilities.

Detailed discussions of the application of these models are provided in Appendix K.

F.10 TRANSPORTATION

F.10.1 Description of Affected Resources

Transportation of any commodity involves a risk to both transportation crewmembers and members of the public. This risk results directly from transportation-related accidents and indirectly from increased levels of pollution from vehicle emissions, regardless of the cargo. Transportation of certain materials such as hazardous or radioactive waste can pose an additional risk due to the unique nature of the materials themselves. To permit a complete appraisal of the environmental impacts of the proposed actions and alternatives, the human health risks associated with transportation of radioactive materials on public highways and railroads were assessed.

Transportation impacts consist of two parts: the impacts of incident-free (routine) transportation and those of transportation accidents. Incident-free transportation and transportation accident impacts may be nonradiological, radiological, or both. Incident-free transportation impacts include radiological impacts on the public and the workers due to the radiation field surrounding the transportation package. Nonradiological impacts of potential transportation accidents include traffic accident fatalities.

Transportation-related risks were calculated and presented separately for workers (truck or rail drivers) and members of the general public (residing or traveling in vehicles along the routes and present at rest and refueling stops). For the incident-free operation, the ROI for the affected population includes individuals living within 800 meters (0.5 miles) of each side of the road or rail. For accident conditions, the ROI for the affected population includes individuals residing within 80 kilometers (50 miles) of the accident; the maximally exposed individual would be an individual located 100 meters (330 feet) directly downwind from the accident. The risk to the affected population is a measure of the radiological risk posed to society as a whole by the alternative being considered. As such, the impact on the affected population was used as the primary means of comparing various alternatives.

F.10.2 Description of Impact Assessment

The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. Only as a result of a severe fire and/or a powerful collision, which have extremely low probabilities, could a transportation package of the type used to transport radioactive material be damaged to the extent that a release of radioactivity to the environment with significant consequences could occur. In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive waste, the consequences of maximum reasonably foreseeable accidents, events with a probability greater than 1×10^{-7} (1 chance in 10 million) per year, were assessed. The latter consequences were determined for atmospheric conditions that would likely prevail during accidents. The analysis used the RISKIND code to estimate doses to individuals and populations (Yuan et al. 1995).

The risks of incident-free effects are expressed in additional LCFs. The risks of radiological accidents are expressed as additional LCFs and, for nonradiological accidents, as additional immediate (traffic) fatalities.

In determining the transportation risks, per-shipment risk factors were calculated for both incident-free and accident conditions using the RADTRAN 5 computer program (Neuhauser and Kanipe 2003) in conjunction with the TRAGIS [Transportation Routing Analysis Geographic Information System] computer program (Johnson and Michelhaugh 2003), which was used to choose representative routes in accordance with U.S. Department of Transportation regulations. The TRAGIS program provides population estimates along the representative routes that are used to determine the population radiological risk factors. These population estimates, generated using data from the 2000 census, are escalated using state-level 2010 census data (Census 2010) that have been adjusted to be route specific, based on the distance of the route in each state. Details on the analysis approach, modeling, and parameter selections are provided in Appendix H, Sections H.4 and H.5.

F.11 SOCIOECONOMICS

F.11.1 Description of Affected Resources

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the proposed actions could affect regional employment, income, and expenditures. Job creation is generally characterized by two types: (1) construction-related jobs, which are transient in nature and limited in duration, and thus less likely to have a longer-term socioeconomic impact; and (2) operations-related jobs in support of facility operations, which are required for a longer period of time and have a greater potential for permanent socioeconomic impacts in the ROI. The ROI for socioeconomics encompasses the counties in which more than 90 percent of the site workers live.

The socioeconomic environment generally includes regional economic indicators, demographic characteristics, and community services available in the area. Economic indicators include employment, the civilian labor force, and unemployment rates. Demographic and community service characteristics include population, housing, education, health, and local transportation information.

F.11.2 Description of Impact Assessment

For each county in the ROI, data were compiled on current socioeconomic conditions, including employment, the civilian labor force, and unemployment. Census data were compiled for population, housing, and community services. Census Bureau population estimates for the ROIs were combined with overall projected workforce requirements for each alternative to determine the extent of impacts on regional economic and demographic (population) characteristics, including levels of demand for housing and community services, and local transportation impacts (see Table F–12).

Table F–12. Socioeconomics Impact Assessment Protocol

Resource	Required Data		Measure of Impact
	Affected Environment	**Alternative**	
Regional Economic Characteristics			
Workforce requirements	Site workforce projections from the Hanford Site and Idaho National Laboratory	Estimated construction, operations, deactivation, and closure activity staffing requirements and timeframes	Workforce requirements added to sites' workforce projections
Region of influence—civilian labor force	Labor force estimates from the U.S. Census Bureau	Estimated construction, operations, deactivation, and closure activity staffing requirements and timeframes	Workforce requirements as a percentage of the civilian labor force
Employment rate	Latest available employment estimates in counties surrounding both sites from the U.S. Census Bureau	Estimated construction, operations, deactivation, and closure activity staffing requirements and timeframes	Potential change in unemployment

Table F–12. Socioeconomics Impact Assessment Protocol *(continued)*

Resource	Required Data: Affected Environment	Required Data: Alternative	Measure of Impact
Demographic Characteristics			
Population and demographics of race, ethnicity, and income	Latest available estimates by county from the U.S. Census Bureau	Estimated effect on population	Potential effects on population
Housing and Community Services			
Housing—percent of occupied housing units (houses and apartments)	Latest available ratios from the U.S. Census Bureau	Estimated housing unit requirements	Potential change in housing unit availability
Public education • Total enrollment • Teacher-student ratio	Latest available information for local school districts or state and county estimates	Estimated effect on enrollment and teacher-student ratio	Projected change in teacher-student ratio
Health care—number of hospital beds and physicians per 1,000 residents	Latest available rates from the U.S. Census Bureau	Estimated effect on health care services	Potential change in the availability of hospital beds or physicians
Local Transportation			
Traffic—number of vehicles	Latest available information on traffic conditions affecting site access roads and intrasite road and local regional transportation networks	Estimated number of commuter and truck vehicle trips to and from the site	Projected change in traffic conditions

F.12 WASTE MANAGEMENT

F.12.1 Description of Affected Resources

Depending on the alternative, the construction, operation, deactivation, and decommissioning of facilities associated with tank waste retrieval, treatment, and disposal and tank closure would result in the following waste types:

- Immobilized high-level radioactive waste—High-level radioactive waste (HLW) that would be immobilized in a borosilicate glass matrix, resulting in a glass waste form.

- Mixed transuranic (TRU) waste—Radioactive waste that is not classified as HLW and contains more than 100 nanocuries of alpha-emitting TRU isotopes per gram of waste with half-lives greater than 20 years, as well as hazardous components regulated under the Resource Conservation and Recovery Act (RCRA) of 1976 (42 U.S.C. 6901 et seq.). All TRU waste would be managed as mixed TRU waste.

- Low-level radioactive waste (LLW)—Radioactive waste that is not classified as HLW, TRU waste, spent nuclear fuel, the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material, or naturally occurring radioactive material.

- Immobilized low-activity waste (ILAW)—Low-activity waste (LAW) immobilized by the Hanford Waste Treatment Plant (WTP) or processed by supplemental treatment (e.g., bulk vitrification, cast stone, or steam reforming). After receiving the necessary approvals, ILAW would be managed as LLW incidental to reprocessing, as defined in DOE Manual 435.1-1. Because it would be a product of Hanford tank waste treatment, it would also be managed as a mixed waste.

- Mixed LLW (MLLW)—LLW that also contains hazardous components regulated under RCRA (42 U.S.C. 6901 et seq.).

- WTP HLW retired melters—Large-capacity, joule-heated, ceramic-lined melters with a theoretical maximum capacity of 3 metric tons of glass per day per melter. These would be managed as HLW.

- LAW retired melters—Large-capacity, joule-heated, ceramic-lined melters with a theoretical maximum capacity of 15 metric tons of glass per day per melter. These would be managed as MLLW.

- Hazardous and dangerous waste—Under RCRA, a solid waste that, because of its characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous waste appears on special EPA lists or possesses at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.). Hazardous waste may also include solid waste designated by Washington State as dangerous, extremely hazardous or mixed waste, acute hazardous waste, or special waste (WAC 173-303-070 through WAC 173-303-100).

- Nonhazardous solid waste—Discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities. This category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (42 U.S.C. 2011 et seq.).

The alternatives could have an impact on existing Hanford facilities devoted to the treatment, storage, and disposal of these categories of waste.

F.12.2 Description of Impact Assessment

As shown in Table F–13, impacts were assessed by comparing the projected waste stream volumes generated from the proposed activities under each alternative with the site's waste management capacities and generation rates. Projected waste generation rates for the proposed activities and projected waste shipments from offsite sources were compared with the site's capacity to manage the waste.

Only the impacts relative to the capacities of the waste management facilities were considered; other environmental impacts of waste management facility operations (human health effects) were evaluated in other sections of this *TC & WM EIS* or in other facility-specific or sitewide National Environmental Policy Act documents. Projected waste generation rates for the proposed activities were compared with site processing rates and the capacities of the treatment, storage, and disposal facilities likely to be involved in managing the additional waste.

Table F–13. Waste Management Impact Assessment Protocol

Resource	Required Data: Affected Environment	Required Data: Alternative	Measure of Impact
Waste management capacity • IHLW • TRU waste • Mixed TRU waste • LLW • ILAW • MLLW • Hazardous waste • Nonhazardous waste • Waste Treatment Plant HLW retired melters • LAW retired melters	Site generation rates (cubic meters per year) for each waste type Offsite shipments (cubic meters per year) for each waste type Site management capacities (cubic meters) or rates (cubic meters per year) for potentially affected treatment, storage, and disposal facilities for each waste type	Generation rates (cubic meters per year) for each waste type	Combination of facility waste generation volumes and other site generation volumes in comparison with the capacities of applicable waste management facilities

Key: HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; LLW=low-level radioactive waste; MLLW=mixed low-level radioactive waste; TRU=transuranic.

F.13 ENVIRONMENTAL JUSTICE

F.13.1 Description of Affected Resources

Environmental justice analysis assesses the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations resulting from implementation of the alternatives in this *TC & WM EIS*. In assessing the impacts, the following definitions of minority individuals and populations and low-income populations were used:

- Minority individuals are identified as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races.

- Minority populations are identified where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

- Low-income populations are identified in an affected area using the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Consumer Income, Series P60-239, *Income, Poverty, and Health Insurance Coverage in the United States: 2010* (DeNavas-Walt, Proctor, and Smith 2011). In 2010, the poverty threshold for an individual living in the United States was an annual income of $11,344. Poverty estimates generated from the Census Bureau's American Community Survey (ACS) period estimates use annual poverty thresholds adjusted for inflation using the consumer price index for all urban consumers published by the U.S. Bureau of Labor Statistics (Census 2011b).

Consistent with the impacts analysis for the public and occupational health and safety, the affected populations were defined as those minority and low-income populations that reside within an 80-kilometer (50-mile) radius centered on the candidate facilities at Hanford and INL. Data relative to race and ethnicity were compiled from the *2010 Decennial Census*, *Summary File 1*, Table P5, Hispanic or Latino Origin by Race (Census 2011a). The most up-to-date data from the *2006–2010 American Community Survey 5-Year Estimates*, Table C17002, Ratio of Income to Poverty in the Past 12 Months, were used to identify low-income populations in this analysis (Census 2011c). The ACS 5-year estimates are the only data sets currently published by the Census Bureau that provide data regarding income and poverty at the block-group level of geography. Historically, data relative to income and poverty are published in the decennial census Summary File 3 (Census 2007). Summary File 3 contains statistics generated based on sample data from the census long form. The 2010 decennial census did not include a separate form for sample data; therefore, it did not contain any data based on sampling. All sample data are now generated from the ACS program. Appendix J details the process by which the affected populations were determined.

F.13.2 Description of Impact Assessment

Adverse health effects are measured in risks and exposure rates that could result in LCFs, as well as other fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk of, or rate of exposure to, an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. The minority and low-income populations are subsets of the general public residing around Hanford and INL; all are exposed to the same hazards generated from various operations at the site. Therefore, estimates of the environmental justice impacts were determined using either the human health risk results or similar methods provided in Appendices H, K, Q, and R. Appendix J provides details of the analysis method and the resulting impacts on the affected populations.

F.14 REFERENCES

BLM (U.S. Bureau of Land Management), 1986, *Visual Resource Inventory*, BLM Manual Handbook 8410-1, Washington, D.C., January 17.

BSSC (Building Seismic Safety Council), 2004a, *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA 450), 2003 Edition, Part 1: Provisions*, National Institute of Building Sciences, Washington, D.C.

BSSC (Building Seismic Safety Council), 2004b, *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA 450), 2003 Edition, Part 2: Commentary*, National Institute of Building Sciences, Washington, D.C.

Census (U.S. Census Bureau), 2007, *Poverty Status in 1989 by Age, 1990 Summary Tape File 3 (STF 3) – Sample Data*, Census 1990 Data Releases, accessed through http://www.census.gov/ on July 17.

Census (U.S. Census Bureau), 2010, *Resident Population Data, Population Density*, accessed through http://2010.census.gov/2010census/data/apportionment-dens-text.php on December 21.

Census (U.S. Census Bureau), 2011a, *2010 Decennial Census Summary File 1*, Table P5 – Hispanic or Latino Origin by Race (Universe – Total Population), accessed through http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml, August 25.

Census (U.S. Census Bureau), 2011b, *American Community Survey, Puerto Rico Community Survey, 2010 Subject Definitions*.

Census (U.S. Census Bureau), 2011c, *2006–2010 American Community Survey 5-Year Estimates*, Table C17002 – Ratio of Income to Poverty Level in the Past 12 Months – Universe: Population for Whom Poverty Status is Determined, accessed through http://www2.census.gov/acs2010_5yr/summaryfile/, December 8.

Chanin, D.I., and M.L. Young, 1997, *Code Manual for MACCS2*, Vol. 1, *User's Guide*, SAND97-0594, Sandia National Laboratories, Accident Analysis/Consequence Assessment Department, Albuquerque, New Mexico, March.

Chatters, J.C., and N.A. Cadoret, 1990, *Archaeological Survey of the 200 East and 200 West Areas, Hanford Site, Washington,* PNL-7264, Pacific Northwest Laboratory, Richland, Washington, March.

DeNavas-Walt, C., B.D. Proctor, and J.C. Smith, 2011, *Income, Poverty, and Health Insurance Coverage in the United States: 2010,* Current Population Reports, Consumer Income, Series P60-239, U.S. Census Bureau, Washington, D.C., September.

Depperschmidt, J.D., 2007, Idaho National Laboratory, Idaho Falls, Idaho, personal communication (email) to M. Burandt, U.S. Department of Energy, Office of River Protection, Richland, Washington, "Fed Ex Address" (regarding response to data request for Idaho National Laboratory, including 2006 nonradiological criteria pollutant releases), May 22.

Duncan, J.P., ed., 2007, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNNL-6415, Rev. 18, Pacific Northwest National Laboratory, Richland, Washington, September.

EPA (U.S. Environmental Protection Agency), 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, Office of Noise Abatement and Control, March.

EPA (U.S. Environmental Protection Agency), 1995, *SCREEN3 Model User's Guide*, EPA-454/B-95-004, Office of Air Quality Planning and Standards, Emissions, Monitoring and Analysis Division, Research Triangle Park, North Carolina, September.

EPA (U.S. Environmental Protection Agency), 2004, *User's Guide for the AMS/EPA Regulatory Model – AERMOD*, EPA-454/B-03-001, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division, Research Triangle Park, North Carolina, September.

EPA (U.S. Environmental Protection Agency), 2006, *Mid-Atlantic Integrated Assessment: Mid-Atlantic Highlands Streams Assessment*, Appendix C, "Glossary," accessed through http://www.epa.gov/maia/html/mah-apc.html, March 3.

EPA (U.S. Environmental Protection Agency), 2009, *Addendum: User's Guide for the AMS/EPA Regulatory Model – AERMOD (EPA-454/B-03-001, September 2004)*, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, North Carolina, October.

Homann, S., 2003, *Introduction to EPIcode*, Version 7.0, Homann Associates, Inc., September.

Johnson, P.E., and R.D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS) User's Manual*, ORNL/NTRC-006, Rev. 0, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June.

Johnson, R.E., 2006, *Calendar Year 2005 Nonradioactive Inventory of Airborne Emissions Report*, DOE/RL-2006-05, Rev. 0, U.S. Department of Energy, Richland Operations Office and Office of River Protection, Richland, Washington, March.

Napier, B.A., 2007, *GENII – Version 2 Users' Guide,* PNNL-14583, Rev. 2, Pacific Northwest National Laboratory, Richland, Washington, March.

Neuhauser, K.S., and F.L. Kanipe, 2003, *RADTRAN 5 User Guide*, SAND2003-2354, Sandia National Laboratories, Albuquerque, New Mexico, July.

PNNL (Pacific Northwest National Laboratory), 2003. This reference is for Official Use Only.

PNNL (Pacific Northwest National Laboratory), 2007. This reference is for Official Use Only.

Sackschewsky, M.R., 2003a, Pacific Northwest National Laboratory, Richland, Washington, personal communication (letter) to C. Johnson, Science Applications International Corporation, Richland, Washington, "Biological Review of the Tank Waste Retrieval, Treatment, and Disposal EIS Project, 200 E and W Areas, ECR #2003-200-044," September 5.

Sackschewsky, M.R., 2003b, Pacific Northwest National Laboratory, Richland, Washington, personal communication (letter) to C. Johnson, Science Applications International Corporation, Richland, Washington, "Supplemental Biological Review of the Tank Waste Retrieval, Treatment, and Disposal EIS Project, 200 E and W Areas, ECR #2003-200-044a," September 11.

Sackschewsky, M.R., and J.L. Downs, 2007, *Ecological Data in Support of the "Tank Closure and Waste Management Environmental Impact Statement,"* Part 2, "Results of Spring 2007 Field Surveys," PNNL-16620, Pacific Northwest National Laboratory, Richland, Washington, May.

SAIC (Science Applications International Corporation), 2010a, *Tank Closure Alternatives, Scaled Data Sets to Support the "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington,"* Germantown, Maryland, June 3, August 26, December 10.

SAIC (Science Applications International Corporation), 2010b, *Fast Flux Test Facility Alternatives, Scaled Data Sets to Support the "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington,"* Germantown, Maryland, November 8.

SAIC (Science Applications International Corporation), 2010c, *Waste Management Alternatives, Scaled Data Sets to Support the "Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington,"* Germantown, Maryland, June 3.

USGS (U.S. Geological Survey), 2007, *Seismic Design Values for Buildings; National Earthquake Hazard Reduction Program (NEHRP) Maps, 1997, 2000*, Earthquake Hazards Program, National Seismic Mapping Project, accessed through http://eqdesign.cr.usgs.gov/html/nehrp-D6.html, http://eqdesign.cr.usgs.gov/html/nehrp.html, January 25.

USGS (U.S. Geological Survey), 2008a, *Earthquake Hazards 201 – Technical Information, What is Probabilistic Ground Motion?, A Simple Description of Seismic Hazard Maps*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/research/hazmaps/ haz101/faq/faq.php, July 16.

USGS (U.S. Geological Survey), 2008b, *Earthquake Hazards 201 – Technical Information, What is Probabilistic Ground Motion?, Uses for the Seismic Hazard Maps*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/research/hazmaps/haz101/faq/faq.php, July 16.

USGS (U.S. Geological Survey), 2008c, *FAQ – Measuring Earthquakes, What are the Earthquake Magnitude Classes?, What is Intensity?, What is the Modified Mercalli Intensity Scale?, What is the Difference Between Intensity Scales and Magnitude Scales?, What are the Different Magnitude Scales, and Why are There so Many?*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/learning/faq.php?categoryID=2, July 28.

USGS (U.S. Geological Survey), 2008d, *Earthquake Topics – Intensity, Magnitude/Intensity Comparison*, Earthquake Hazards Program, accessed through http://earthquake.usgs.gov/learning/topics.php?topicID=77& topic=Intensity, July 16.

Wald, D.J., V. Quitoriano, T.H. Heaton, and H. Kanamori, 1999, "Relationships Between Peak Ground Acceleration, Peak Ground Velocity, and Modified Mercalli Intensity in California," *Earthquake Spectra*, Vol. 15, No. 3, pp. 557–564, August.

Yuan, Y.C., S.Y. Chen, B.M. Biwer, and D.J. LePoire, 1995, *RISKIND – A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, ANL/EAD-1, Argonne National Laboratory, Argonne, Illinois, November.

Code of Federal Regulations

7 CFR 657.5, Natural Resources Conservation Service, U.S. Department of Agriculture, "Prime and Unique Farmlands: Identification of Important Farmlands."

7 CFR 658.3, Natural Resources Conservation Service, U.S. Department of Agriculture, "Farmland Protection Policy Act: Applicability and Exemptions."

7 CFR 658.7, Natural Resources Conservation Service, U.S. Department of Agriculture, "USDA Assistance with Federal Agencies' Reviews of Policies and Procedures."

33 CFR 328.3, Corps of Engineers, Department of the Army, U.S. Department of Defense, "Definition of Waters of the United States."

40 CFR 50, U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR 51, U.S. Environmental Protection Agency, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans," Appendix W, "Guideline on Air Quality Models."

40 CFR 51.165, U.S. Environmental Protection Agency, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans: Permit Requirements."

40 CFR 61, U.S. Environmental Protection Agency, "National Emission Standards for Hazardous Air Pollutants."

40 CFR 81, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes."

40 CFR 81.313, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Idaho."

40 CFR 81.348, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes," Subpart C, Section 107, "Attainment Status Designations: Washington."

United States Code

7 U.S.C. 4201 et seq., Farmland Protection Policy Act of 1981.

16 U.S.C. 470 et seq., National Historic Preservation Act of 1966.

16 U.S.C. 1531 et seq., Endangered Species Act of 1973.

33 U.S.C. 1251 et seq., Clean Water Act of 1972.

42 U.S.C. 300(f) et seq., Safe Drinking Water Act of 1974.

42 U.S.C. 2011 et seq., Atomic Energy Act of 1954.

42 U.S.C. 6901 et seq., Resource Conservation and Recovery Act of 1976.

42 U.S.C. 7401 et seq., Clean Air Act of 1970.

42 U.S.C. 7472 et seq., Prevention of Significant Deterioration of Air Quality: Initial Classifications.

Washington Administrative Code

WAC 173-60, Washington State Department of Ecology, "Maximum Environmental Noise Levels," Olympia, Washington.

WAC 173-303, Washington State Department of Ecology, "Dangerous Waste Regulations," Olympia, Washington.

U.S. Department of Energy Manuals, Orders, and Standards

DOE Order 414.1D, *Quality Assurance*, April 25, 2011.

DOE Order 420.1B, *Facility Safety*, Change 1, April 19, 2010.

DOE Manual 435.1-1, *Radioactive Waste Management Manual*, Change 2, June 8, 2011.

DOE Standard 1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, January 2002.

DOE Standard 1023-95, *Natural Phenomena Hazards Assessment Criteria*, April 2002.